

## CLAIMS

What is claimed is:

1. A rotary motion machine, comprising:
  - a) at least one radially expandable piston defining an inner chamber having a volume that varies upon radial expansion and contraction of the piston;
  - b) a core defining, at least in part, a cylinder in which the piston is positioned;
  - c) a rotor rotationally movable relative to the core and being rotated by a relatively incompressible fluid driven by expansion of the piston; and
  - d) at least one magnet associated with the rotor that, upon rotation of the rotor, generates electricity in a cooperatively arranged coil.
2. The rotary motion machine of Claim 1, wherein the magnet is a permanent magnet or an electromagnet.
3. The rotary motion machine of Claim 1, wherein the electricity has a frequency of 50 or 60 hertz.
4. An electricity generator, comprising:
  - at least one magnet rotated by a rotary motion machine; and
  - a coil positionable adjacent to a path of the at least one magnet wherein electricity is generated in the coil.
5. The electricity generator of Claim 4, wherein the rotary motion machine includes:
  - a) at least one radially expandable piston defining an inner chamber having a volume that varies upon radial expansion and contraction of the piston;

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- b) a core defining, at least in part, a cylinder in which the piston is positioned; and
  - c) a rotor supporting the at least one magnet, the rotor being rotationally movable relative to the core and being rotated by a relatively incompressible fluid driven by expansion of the piston.
- 6. A fluid injector comprising two concentric tubes movable with respect to one another, each tube having a plurality of apertures that cooperate to atomize at least a portion of fluid disposed within the tubes, movement of one of the tubes preventing the fluid from being atomized.
  - 7. The fluid injector of Claim 6, wherein the plurality of apertures are disposed along substantially the full length of the tubes.
  - 8. The fluid injector of Claim 6, wherein the relative movement of the tubes corresponds to the amount of fluid that is atomized.
  - 9. The fluid injector of Claim 6, wherein the tubes are formed from a high temperature material.
  - 10. The fluid injector of Claim 6, wherein the fluid is preheated within the tubes.
  - 11. The fluid injector of Claim 6, wherein the fluid includes at least one of a combustible fuel, plastic, melt, resins, and plastic melt.
  - 12. The fluid injector of Claim 6, wherein the apertures are substantially circular having a diameter between about 0.5 and 5 micrometers.

13. A fluid injector comprising two concentric tubes, each tube having a plurality of apertures disposed along a common longitudinal axis of the tubes, the plurality of apertures being configured to atomize a fluid.
14. The fluid injector of Claim 13, wherein relative motion between the tubes contains the fluid in the tubes in a first position and allows at least a portion of the fluid to be atomized in a second position.
15. A rotary motion machine, comprising:
  - a) at least one radially expandable piston defining an inner chamber having a volume that varies upon radial expansion and contraction of the piston;
  - b) a core defining, at least in part, a cylinder in which the piston is positioned;
  - c) a rotor rotationally movable relative to the core; and
  - d) a fuel injector disposed within the piston, the fuel injector including a first member disposed along a longitudinal axis of the inner chamber of the piston, the first member including an inner cavity and having a first plurality of apertures extending from the inner cavity to an outside surface of the first member, the fuel injector also comprising a second member surrounding the first member, the second member including a second plurality of apertures that extend from an inside surface to an outside surface of the second member, the first and second plurality of apertures cooperating in such a way as to, in a first position, contain fluid disposed within the inner cavity of the first member and, in a second position, allow at least a portion of fluid disposed within the inner cavity of the first member to pass through the first and second plurality of apertures and into the inner chamber of the piston.

16. The rotary motion machine of Claim 15, wherein the aperture geometry of the first and second plurality of apertures is small enough to atomize fluid passing therethrough.
17. The rotary motion machine of Claim 15, wherein the rotary motion machine has a combustion temperature of about 1800 degrees Celsius.
18. The rotary motion machine of Claim 15, wherein the first and second plurality of apertures are geometrically congruent.
19. A radially expandable piston for use in a rotary motion machine comprising a spiral of thin, flexible material coiled up about a central axis, the spiral including a first end and a second end positionable adjacent a first core plate and a second core plate, respectively, of the rotary motion machine, the first end and the second end of the spiral including in-folded portions that create a seal against the first core plate and the second core plate.
20. The radially expandable piston of Claim 19, wherein the spiral is configured to allow a fluid in between spiral layers.
21. The radially expandable piston of Claim 20, wherein projections are used to form portals for allowing fluid in between spiral layers.
22. The radially expandable piston of Claim 19, further comprising a sealing member attachable to the spiral at an inner end for creating a seal against the spiral.

23. The radially expandable piston of Claim 19, further comprising a folded portion at an inner end of the piston to prevent fluid from reaching an inner chamber defined by the spiral.
24. The radially expandable piston of Claim 19, wherein the spiral includes a foil of amorphous material having a strip of a crystalline material for causing the spiral to expand after contraction.
25. A rotary motion machine, comprising:
  - a) at least one radially expandable piston defining an inner chamber that varies upon radial expansion and contraction of the piston, the piston including a spiral of thin, flexible material having a first end and a second end;
  - b) a core defining, at least in part, a cylinder in which the piston is positioned; and
  - c) a first core plate and a second core plate, wherein the first end and the second end of the spiral are positionable adjacent the first core plate and the second core plate, respectively, the first end and the second end including in-folded portions that create a seal against the first core plate and the second core plate.
26. The rotary motion machine of Claim 25, further comprising a sealing member attachable to an inner end of the piston for creating a seal against the spiral.
27. The rotary motion machine of Claim 25, wherein the spiral is configured to prevent a relatively incompressible fluid disposed outside the inner chamber from reaching therein.

28. The rotary motion machine of Claim 25, wherein the first core plate and the second core plate include  $\text{Al}_2\text{O}_3\text{N}_2$ .
29. A rotary motion machine, comprising:
  - a) at least one radially expandable piston defining an inner chamber having a volume that varies upon radial expansion and contraction of the piston;
  - b) a core defining, at least in part, a cylinder in which the piston is positionable, the core having a plurality of apertures through which fluid flows to cool the machine; and
  - c) a rotor rotationally movable relative to the core and being rotated by a relatively incompressible fluid driven by expansion of the piston.
30. The rotary motion machine of Claim 29, wherein the piston, core, and rotor are encased within a housing, the housing forming at least part of fluid channels that cooperate with the plurality of apertures in the core to provide fluid flow through the machine for cooling thereof.
31. The rotary motion machine of Claim 30, wherein the housing defines at least part of an anechoic chamber for dampening engine noise.
32. The rotary motion machine of Claim 29, further comprising a second core having at least one associated piston stacked on top of the core.
33. A radially expandable piston for use in a rotary motion machine comprising a spiral of thin, flexible material coiled about a central axis, the spiral being formed from a material having a melting temperature of about 3,200 degrees Celsius.

34. The piston of Claim 33, wherein the piston has a thickness of about 25 micrometers.
35. The piston of Claim 33, wherein the piston includes an amorphous, non-crystalline structure.
36. The piston of Claim 33, wherein the piston is formed from a heat-reflective material.
37. The piston of Claim 33, further comprising a strip of material attachable to the spiral for causing the spiral to expand after being contracted.
38. A radially expandable piston for use in a rotary motion machine comprising a spiral of thin, flexible material coiled about a central axis, the spiral being formed from a heat-reflective material.
39. A spiral of thin, flexible material coilable about a longitudinal axis for use in a rotary motion machine, the spiral including a first end configured to allow fluid in between coils.
40. The spiral of Claim 39, wherein the spiral includes a second end that includes a sealing member for creating a seal against the spiral to prevent fluid from reaching an inner chamber defined by the spiral.
41. A rotary motion machine, comprising:
  - a) at least one radially expandable piston defining an inner chamber having a volume that varies upon radial expansion and contraction of the piston;
  - b) a first core plate and a second core plate bounding the piston on first and second ends thereof; and

- c) at least one intake valve and at least one outlet valve mountable on the first core plate or the second core plate for communicating with the inner chamber of the piston, the intake valve and the outlet valve being substantially flush with that surface of the first core plate or the second core plate that bounds the piston.
- 42. The rotary motion machine of Claim 41, wherein the intake valve and the outlet valve are mounted on the first core plate and the second core plate, respectively.
- 43. The rotary motion machine of Claim 41, wherein the intake valve allows pre-compressed fluid into the chamber.
- 44. The rotary motion machine of Claim 41, wherein the outlet valve allows exhaust produced from fuel combustion within the chamber to leave the chamber.
- 45. The rotary motion machine of Claim 41, wherein the intake and outlet valves are shaped to maximize the amount of area above/below the inner chamber.
- 46. A rotary motion machine, comprising:
  - a) at least one radially expandable piston defining an inner chamber having a volume that varies upon radial expansion and contraction of the piston;
  - b) a first core plate and a second core plate bounding the piston on each end;
  - c) at least one intake valve and at least one outlet valve mountable on the first core plate or the second core plate; and
  - d) the second core plate defining at least part of an anechoic chamber adjacent at least the outlet valve for minimizing noise associated with fuel combustion within the piston.



47. The rotary motion machine of Claim 46, wherein a housing forms at least part of the anechoic chamber.
48. A method for operating a rotary motion machine, comprising:
  - a) atomizing and injecting a liquid fuel into and along a length of a chamber defined by a radially expandable piston, the fuel combustion creating exhaust and causing the piston to radially expand;
  - b) replacing substantially all of the exhaust with pre-compressed fluid as the piston is caused to contract; and
  - c) repeating steps (a) and (b).
49. The method of Claim 48, wherein the step of replacing substantially all of the exhaust with pre-compressed fluid is carried out at least while the piston is caused to contract.
50. The method of Claim 48, wherein the piston is caused to contract by a relatively incompressible fluid propelled by a second radially expandable piston expanding due to fuel combustion therein.
51. The method of Claim 50, further comprising rotating a rotor with the relatively incompressible fluid.
52. The method of Claim 51, further comprising generating electricity by motion of at least one magnet associated with the rotor relative to a cooperatively arranged coil.
53. The method of Claim 48, wherein at least one fuel injector that selectively injects liquid fuel into the chamber, a fluid intake valve that allows pre-

compressed fluid into the chamber, and at least one outlet valve that selectively allows the exhaust to exit the chamber are closed during the fuel combustion.

54. The method of Claim 53, further comprising opening the fluid intake valve and the outlet valve about when the piston has expanded to about its maximum dimension to allow the exhaust to leave the chamber as the piston is caused to contract.
55. The method of Claim 54, further comprising closing the outlet valve about when substantially all of the exhaust has been replaced by the compressed fluid.
56. The method of Claim 55, wherein substantially all of the exhaust has been replaced by the pre-compressed fluid about when the piston has contracted to about one-half its maximum diameter.
57. The method of Claim 56, further comprising closing the fluid intake valve and the outlet valve about when the piston is contracted to about one-half its maximum diameter, the continued contraction of the piston further compressing the pre-compressed fluid.
58. The method of Claim 56, wherein the fluid injector injects fuel into the chamber about when the piston is contracted to its minimum diameter to atomize and inject a liquid fuel into and along a length of the chamber.
59. A rotary motion machine, comprising:
  - a) at least one radially expandable piston defining an inner chamber having a volume that varies upon radial expansion and contraction of the piston, the piston being formed from a heat-reflective material to contain heat produced by fuel combustion within the chamber;

- b) a core defining, at least in part, a cylinder in which the piston is positionable; and
  - c) a rotor rotationally movable relative to the core and being rotated by a relatively incompressible fluid driven by expansion of the piston.
60. The rotary motion machine of Claim 59, further comprising at least one magnet associated with the rotor for generating electricity in a cooperatively arranged coil by motion of the magnet relative to coil.
61. A rotary motion machine, comprising:
- a) at least one radially expandable piston defining an inner chamber having a volume that varies upon radial expansion and contraction of the piston;
  - b) a core defining, at least in part, a cylinder in which the piston is positionable, the core including a plurality of apertures for cooling the core for increasing the thermal efficiency of the machine thereby increasing torque; and
  - c) a rotor rotationally movable relative to the core and being rotated by a relatively incompressible fluid driven by expansion of the piston.
62. The rotary motion machine of Claim 61, further comprising a fluid circulated through the plurality of apertures for cooling the core.
63. A rotary motion machine, comprising:
- a) at least one radially expandable piston defining an inner chamber having a volume that varies upon radial expansion and contraction of the piston;
  - b) a core defining, at least in part, a cylinder in which the piston is positionable; and
  - c) a rotor rotationally movable relative to the core and being rotated by a relatively incompressible fluid driven by expansion of the piston;

the piston providing a maximum torque for rotating the rotor at about the initial combustion of fuel within the chamber.

64. A rotary motion pump, comprising a rotor driven about a central axis, the rotor having bearing surfaces that force a relatively incompressible fluid to cause at least one radially expandable piston to expand and contract about a longitudinal axis thereof, the motion of the expansion and contraction of the piston pumping a fluid along the longitudinal axis of the piston, the pump further including a one-way valve on each end of the piston to control the direction that the fluid is pumped.
65. The rotary motion pump of Claim 64, wherein the rotor is driven by a belt.
66. The rotary motion pump of Claim 64, wherein the pump is used in a medical device.
67. The rotary motion pump of Claim 66, wherein the device includes an artificial heart to pump blood.